REMARKS

In the Office Action, the Examiner rejected Claims 1, 8 and 13 under 35 U.S.C. §102 as being fully anticipated by U.S. Patent 5,940,545 (Kash, et al.) and rejected all of Claims 1-17 under 35 U.S.C. §103, first, as being unpatentable over U.S. Patent 4,680,635 (Khurana) in view of U.S. Patent 5,175,495 (Brahme, et al.), and second as being unpatentable over Khurana in view of European patent application 0639778 (Prasad).

Independent Claims 1, 8 and 13 are being amended to better define the subject matters of these claims. Also, Claims 2, 9 and 14 are being amended to improve the form of the claims and to add a feature to the claims, and new Claims 18-20, which are dependent from Claims 1, 8 and 13 respectively, are being added to describe preferred features of the invention. In addition, this opportunity is being taken to make several minor editorial corrections to the specification, care being taken to avoid adding new matter.

For the reasons discussed below, Claims 1-20, as presented herewith, patentably distinguish over the prior art and are allowable. The Examiner is, accordingly, respectfully requested to reconsider and to withdraw the rejections of Claims 1-17 and to allow these claims and new Claims 18-20.

The present invention, generally, relates to methods and systems for testing an integrated circuit. In the method of this invention, optical emissions are obtained over a defined period of time and from a defined area of an integrated circuit, and these emissions are resolved, by photon timing, to estimate the number of switching events occurring. Also, an optical emission model is provided that represents one of a group of defined conditions, and the optical emission from the integrated circuit is compared with the optical emission model to determine whether the one of the group of conditions is present in that circuit.

The cited references disclose various emission microscopes for inspecting integrated circuits. There is, though, an important general difference between the present invention and the methods and systems shown in the prior art. This general difference is that, with the present invention, a time resolved optical emission from the integrated circuit is compared with an emission model to determine if one of a group of predefined conditions is present. With the prior art, in contrast, while an emission spectrum may be analyzed to obtain information about that circuit, that emission is not compared with an emission model to determine if one of a group of predefined conditions is present in the circuit.

Specifically, Kash, et al. shows a procedure for obtaining a time resolved optical emission. Kash, et al's teaching as to what this emission can be used for is very general. For example, as discussed in column 6, lines 35-45, Kash, et al. discloses, very generally, that information can be obtained from that emission. Kash, et al. further discloses, in column 7, lines 10-15, that this emission can, in a general sense, be compared to another image. Kash, et al. does not disclose or suggest specifically providing an emission model that represents one of a defined group of conditions, and comparing the emission from the integrated circuit with that model to determine specifically if that one predefined condition is present.

The other references of record fail to disclose or suggest this specific feature of the present invention – that is, providing an emission model representing one of a group of defined conditions and comparing the emissions from the integrated circuit to that model to determine if that one condition is present.

In addition, Applicants respectfully submit that the rejections of the claims over the cited prior art may be based on a misunderstanding on the part of the Examiner that the present application is aimed at patenting an emission microscope, whereas it is actually directed to an application of an emission microscope.

The Examiner cites the prior art of Prasad, Brahme, Bruce and Khurana. Prasad is an application of an emission microscope to direct band gap HBTs which emit light under dc bias conditions, which is different from the present invention. The failures Prasad considers such as latch-up are individual device failures. Prasad says Observations in this manner allow an engineer to determine whether the HBT based integrated circuit is operating properly, and if not where the problem is. The present invention addresses problems that are not localized to a single device but to large groups of devices. In the practice of this invention, it is generally know from electrical tests that there is a problem, and this invention attempts to identify the NATURE as well as the location of the problem, for example, whether there is loading of the power supply, heating in a region of the chip, etc.

Bruce, Brahme et al. and Khurana all disclose emission microscopes and improvements in emission microscopy technology aimed at diagnostics on failures of individual devices in integrated circuits. Bruce for example proposes the use of catadioptic microscopes, cryogenically cooled back thinned CCDs, and various types of dispersive elements for obtaining the spectra of the emission. It is clear that the disclosed system relies on prior art such as Khurana to apply this microscope to the identification of latch up, gate oxide leakage, etc. However, Bruce does not describe, and it is not obvious what modifications could be devised by an individual skilled in the art, to address the problems which are discussed in the present application.

Brahme et al. addresses the use of emission microscopy to observe leakage sites in powered up ICs. The present invention may be used effectively to address problems in circuits that have no device failures due to leakage and therefore are distinct from the procedures of Brahme et al.

Khurana discloses an emission microscope and its use in identifying different types of device failures. Contrary to the Examiner's statements in connection with claims 2, 9, and 14, though, Khurana does not address the problems of local power supply loading, heating of the chip etc. These are not mentioned in the abstract, nor are they mentioned on page 6 lines 39-51. Khurana does mention "hot electrons" on page 6, lines 39-51. However, hot electrons are electrons whose energy distribution is described by a Maxwellian with an effective temperature greater than the lattice temperature. Hot electrons in CMOS circuits are out of equilibrium with the lattice whose temperature can be at ambient. In the case of the preferred embodiment of this invention, the local heating represents a change in the lattice/thermodynamic temperature of the material and not a hot electron effect. While Khurana talks about power distribution systems to operate the devices under test, he never considers what happens if the system is loaded by the devices being tested. As mentioned earlier, the present application is not an effort to patent an emission microscope but how it can be used to solve a particular problem.

In the Office Action, the Examiner specifically cited lines 51-54 of column 4 and lines 48-51 of column 8 of Khurana as disclosing a comparison of optical emission. Applicants respectfully submit that these portions of Khurana, do not disclose any actual comparison of a model with obtained emissions. More specifically, in lines 51-54 of Column 4 of Khurana, it is explained that an image may be separated into two – a bright image and a faint image. The

faint image is processed and then recombined with the bright image, and the combination is then used. There is, however, no comparison of the two images. Similarly, lines 48-51 of Column 8 of Khurana disclose that images can be combined, but there is no teaching of comparing two images to determine if a particular condition is present.

Independent Claims 1, 8 and 13 are herein being amended to more positively describe the above-discussed feature of this invention. In particular, each of these claims is being amended to indicate that the provided optical emission model represents one of a group of defined conditions, and that the optical emission from the integrated circuit is compared with that provided optical emission model to determine whether that one of the group of conditions is present in the integrated circuit.

This feature is of significant utility because, as a result, the present invention is able to identify specific conditions. These conditions may include conditions that are not the result of any faulty operation of any gates on the circuit, but are the result of proper operation of those gates.

Because of the above-discussed differences between Claims 1, 8 and 13 and the prior art, and because of the advantages associated with those differences, these claims patentably distinguish over the prior art and are allowable. Claims 2-7 and 18 are dependent from Claim 1 and are allowable therewith; and Claims 8-12 and 19 are dependent from, and are allowable with, Claim 7. likewise, Claims 14-17 and 20 are dependent from Claim 13 and are allowable therewith.

In light of the above discussion, the Examiner is respectfully asked to reconsider and to withdraw the rejection of Claims 1, 8 and 13 under 35 U.S.C. §102 and the rejection of Claims 1-17 under 35 U.S.C. §103, and to allow Claims 1-20. If the Examiner believes that a telephone conference with Applicants' Attorneys would be advantageous to the disposition of this case, the Examiner is requested to telephone the undersigned.

Respectfully submitted,

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